Current Status of Road Safety Management in Japan and Approach for Improvement

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ABSTRACT

The number of traffic accident casualties in Japan tends to decrease recently, however it is still severe condition to conduct safety measures effectively in left hazardous spots.

In order to support and promote effective planning, designing and evaluation of road safety measures, National Institute for Land and Infrastructure Management (NILIM) created tools for road safety management such as “Road safety manual[1]”, “Guideline for improving road safety at hazardous spots[1]” and “Database on road safety measures”. These manual, guideline and database are introduced to conduct effective road safety measures based on scientific mechanism, technical information or knowledge obtained from past experience of road safety measures.

In this papers, current status of road safety management in Japan that has practical experience of operation for several years and our challenge for the future such as how to select spots where safety measures are required or how to use intelligent information collected by experimental studies, prove cars or simulation are discussed.

1. INTRODUCTION

The number of traffic accident casualties in Japan reached at 16,765 early in the 1970’s. This is the worst record in history as shown in Figure-1. The first traffic safety programs (5 years) started in 1971. After that the number of traffic accident in Japan decreased drastically. In an early stage of traffic safety program in 1970’s basic safety measures such as building sidewalk or pedestrian overpasses were conducted mainly. These safety measures were worked effectively in the terrible traffic safety situation called “traffic war” in 1970’s Japan.

After the end of 1970’s the number of traffic accidents starts to increase again. This change means that the effectiveness of basic safety measures in an early stage had not

continued so long. Therefore, more strategic and scientific approach of road safety measures was required. The Ministry of Land, Infrastructure and Transport (MLIT) started to promote strategic road safety management using scientific information or indicators in 2000's. As a result of various types of safety measures that include scientific approach, the number of traffic accidents started to decrease again in Japan recently. However it is still severe condition to conduct safety measures effectively in left hazardous spots and decrease traffic fatalities reaching at more than 5,000.

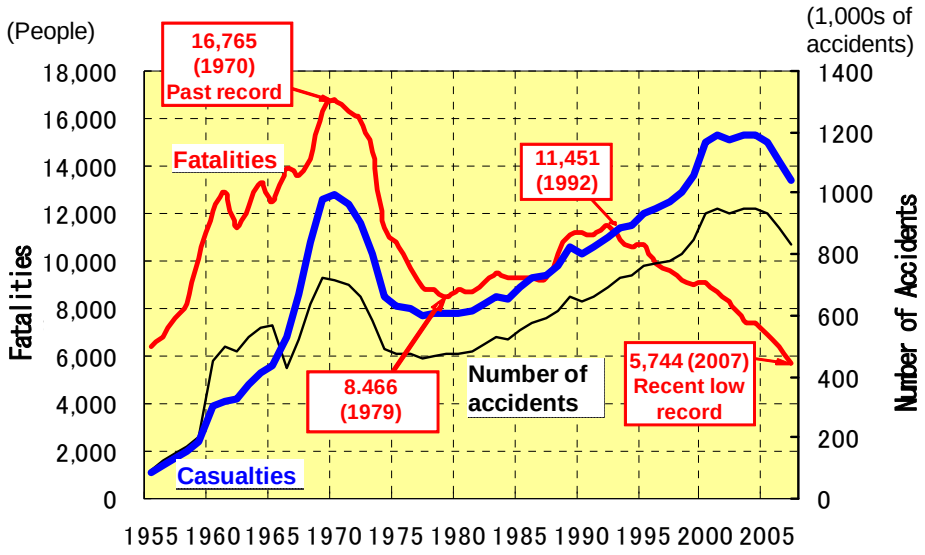


Figure-1 The number of traffic accident in Japan

2. Road safety management in Japan

MLIT promotes to conduct strategic road safety management based on scientific information or indicators. As shown in Figure-2, the cycle of road safety management consist of several stages such as "selection of hazardous spots where measures are required", "analysis of traffic accident occurrence mechanism", "planning of safety measures based on the accident mechanism", "evaluation of safety measure effectiveness" and "sharing information or knowledge obtained from past experience of safety measures. This process is described in road safety manual published in 2005.

In order to support effective road safety management, there are some tools such as "guideline for improving road safety at hazardous spots" and "database on road safety measures". "Guideline for improving road safety at hazardous spots" shows examples of road safety measures based on the analysis of actual safety measures conducted in 557 hazardous spots all over Japan. "Database on road safety measures" contains information on safety measure such as road structure or traffic condition, situation of accident occurrence and result or effect of safety measures.

In this management system, road administrator has a chance to get advice from specialists. NILIM considers that knowledge or judgment of person is important to conduct strategic safety measures as well as using scientific and objective data.

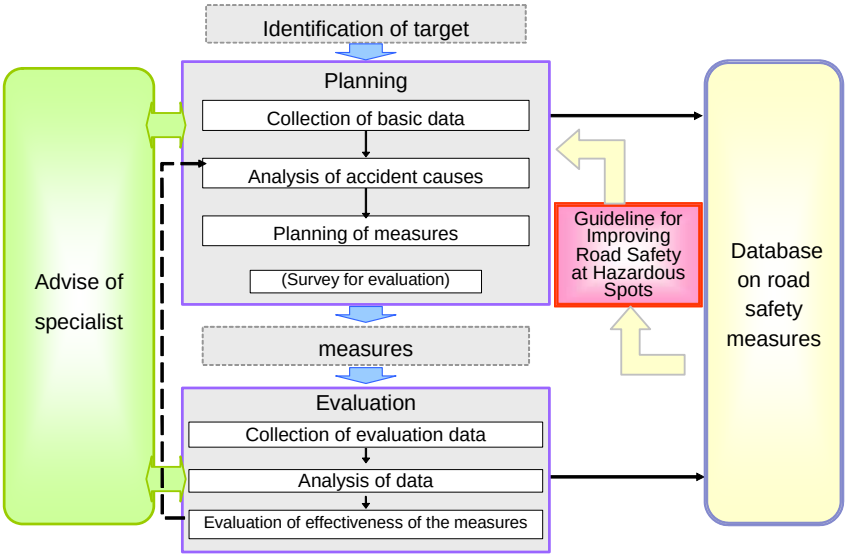


Figure-2 A cycle of road safety management

3. Decision making of spots where measures are required

In order to reduce traffic accidents effectively, it is important to conduct safety measures focusing on the specific hazardous spots where risk of traffic accident is higher. In Japan, hazardous spots are selected based on an indicator called accident rate. Accident rate is defined the number of traffic accidents divided by the number of vehicles and running distance (cases / 100 million vehicle-km). Figure-3 shows a map of hazardous spots based on accident rate around Tokyo metropolitan area. Arterial road administrators such as the Ministry of Land, Infrastructure Transport and Tourism (MLIT), prefectures and designated major cities in Japan share these data and open to the public in order to explain the necessity or priority of road safety measures.

Figure-4 shows the relationship between the number of traffic accidents and the length of arterial roads. As shown in figure-4 most of traffic accidents on arterial roads tend to occur in specific spots, 56% of traffic accidents occur in 9% length of all arterial roads in Japan. Therefore, in order to reduce traffic accidents effectively, road administrator should focus on these specific hazardous spots where accident rate is in top class.

Figure-5 shows the relationship between the value and the order of accident rate. Hazardous spots where accident rate is more than 100 are regarded as prioritized spots for safety measure. As a result of recent safety measures using accident rate in decision making process, average of accident rate of arterial roads in Japan is steadily decreasing.

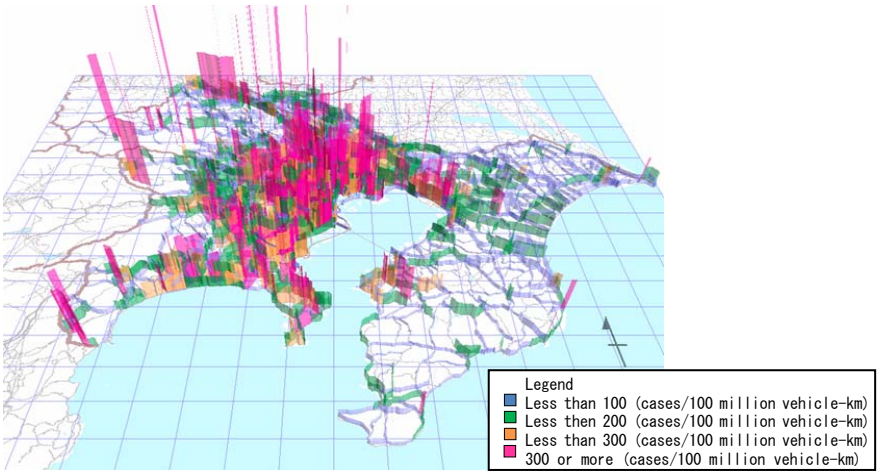


Figure-3 Map of hazardous spots in Tokyo metropolitan area

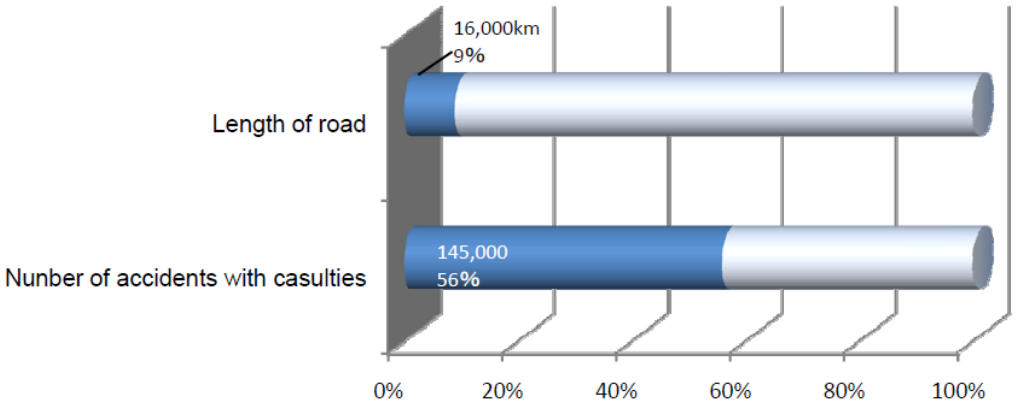


Figure-4 Characteristics of accident occurrence on arterial roads

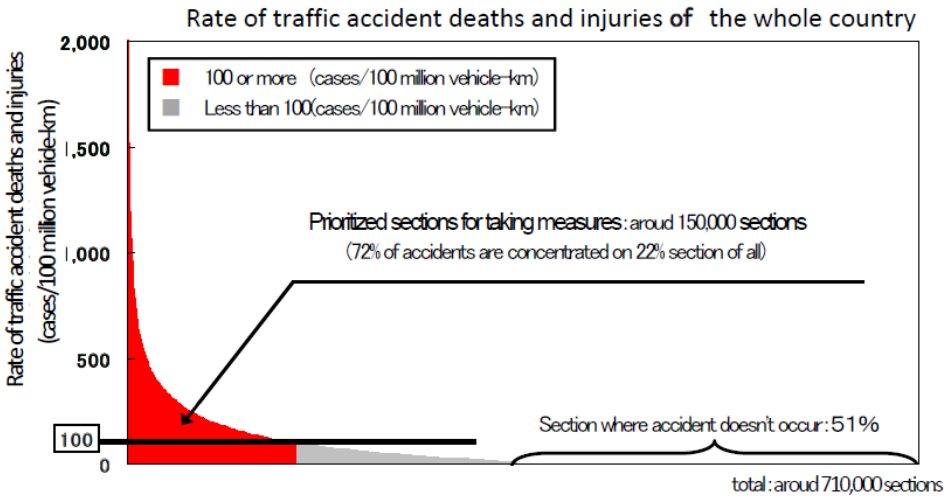


Figure-5 Relationship between the value and the order of accident rate

On the other hand, road safety management in Japan is confronting a problem that we must shift the target of safety measures to the spots where it is difficult to conduct safety measures. In general, road structure and traffic situation of hazardous spots where so many traffic accidents occur have features as follow.

(1) Heavy traffic condition, chronic congestion

(2) High density roadside buildings or houses. No extra site for safety measures

(3) Complex and complicated road shape or structure

These problems are inevitable considering the Japanese land and infrastructure conditions. Therefore, we need to develop more advanced methods for road safety measures to reduce the number of traffic accidents effectively to the future. NILIM is trying to develop an advanced planning method for safety measures using scientific information described in next section.

Picture-1 Traffic condition of spot where so many accidents occur

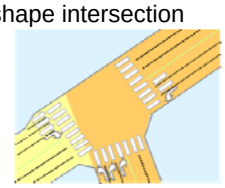
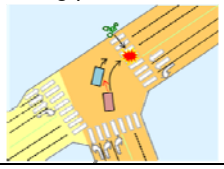
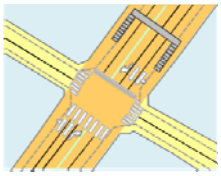
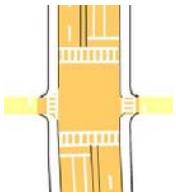
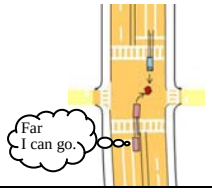
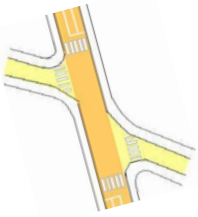
4. Planning of road safety measures using scientific information

4.1 Experimental study

In order to evaluate effectiveness and feasibility of the planning method for safety measures based on experimental studies in hazardous spots where mechanism of accident occurrence is complex, NILIM is conducting case study on safety measures planning based on the experimental results in several intersections[2]. Table-1 shows recent examples of experimental studies conducted by NILIM. As shown in Table-1, the result of case studies reveals that experimental studies clarify mechanism of traffic accidents occurrence by analyzing the detail behavior of drivers.

It is estimated that safety measures in left hazardous spots became more difficult in the future. NILIM try to clarify the road or traffic condition that experimental studies is useful, and promote to conduct experimental studies by road administrators.

Table-1　Recent examples of experimental studies

Month / Year	Route City	Spots	Tests	Results
1 / 2007	408 Tsukuba	T-shape intersection 	20 testee 4 times tests /person 1 prove car 1 eye camera 3 CCD camera 3 fixed camera interview to testee	Caution to the next car. Missing pedestrian. 
1 / 2008	6 Katushika Tokyo	Intersection with bike lane 	20 testee 4 times tests /person 1 prove car 1 eye camera 1 fixed camera 3 CCD camera interview to testee	Caution to the cars Missing bike (picture-2) 
2 / 2009	51 Inashiki	Intersection without signal 	20 testee 4 times tests /person 1 prove car 1 eye camera 2 fixed camera 3 CCD camera interview to testee	Overspeed in the intersection. Misunderstanding of the distance from the other cars. 
3 / 2009	6 Hitachi	Intersection with irregular shape 	21 testee 4 times tests /person 1 prove car 1 eye camera 2 fixed camera 3 CCD camera interview to testee	Overspeed in the intersection. Caution to the turning direction. 

Picture-2 Example of driver's behavior

4.2 Prove data collection

The number of taxis or trucks that installed drive recorder is increasing rapidly in Japan to reduce accidents and solve troubles speedy. By using drive recorder, we can collect scientific data such as velocity, acceleration, brake operation or video data of front camera easily. Figure-6 shows example data of drive recorder. Figure-7 shows plots of hazardous incidents collected by drive recorder for 5 years in Tokyo area by the Society of Automotive Engineers of Japan in the cooperation with a taxicab company.

NILIM conducted investigation on characteristic of probe data collected by drive recorder installed trucks or taxis. NILIM's investigations clarified that probe data collected by drive recorder is effective to plan road safety measures. Especially, it is inevitable for safety measures based on scientific information in residential roads that is not have any database on road safety measures. However, drive recorder data include various types of data such as vibration on ruggedness. Therefore, we need to develop extracting methods of hazardous incidents from drive recorder data. And we need to create data collecting method collaborating with private companies.

Figure-6 Example of drive recorder data

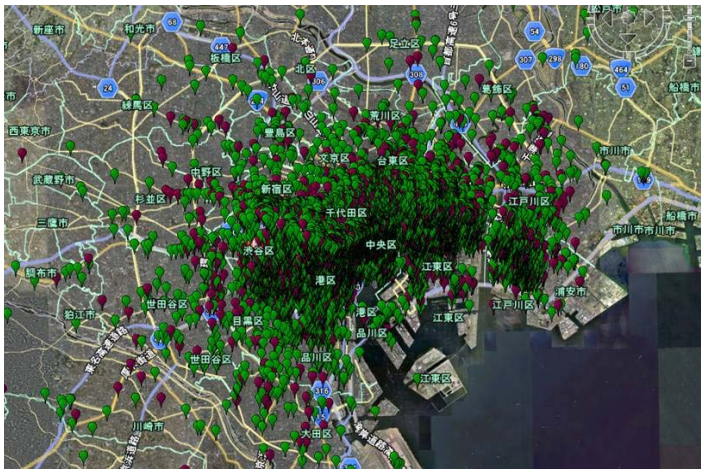


Figure-7 Hazardous incidents from drive recorder in Tokyo area

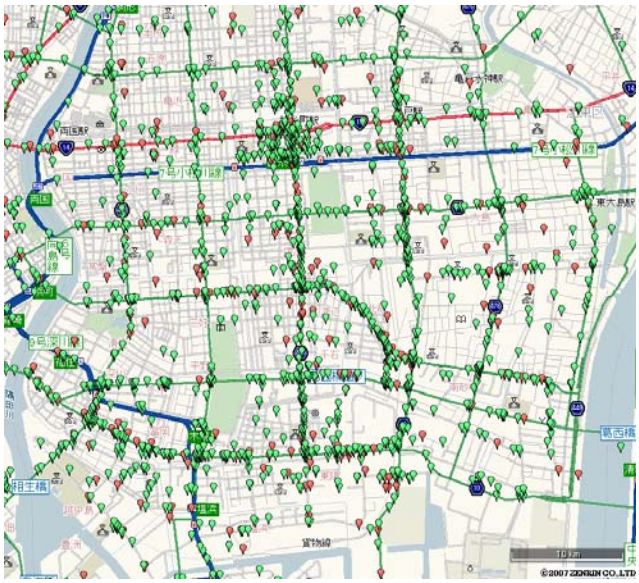


Figure-8 Hazardous incidents from drive recorder in Koto area

4.3 Driving simulation

In order to evaluate effectiveness of road safety measures before constructing physical devises, NILIM conducted investigation on feasibility of using driving simulator for planning of road safety measures [2]. As a result of investigation, driving simulator has sufficient probability of applying to plan road safety measures. For example, effectiveness of road marking shown in Figure-9 was clarified by evaluating the change of driver's behavior in this investigation.

Figure-9 CG data used in driving simulation

5. Database on road safety measures

In order to share information or knowledge obtained from past experience of road safety measures, NILIM created database on road safety measures. Table-2 shows examples of items registered in the database.

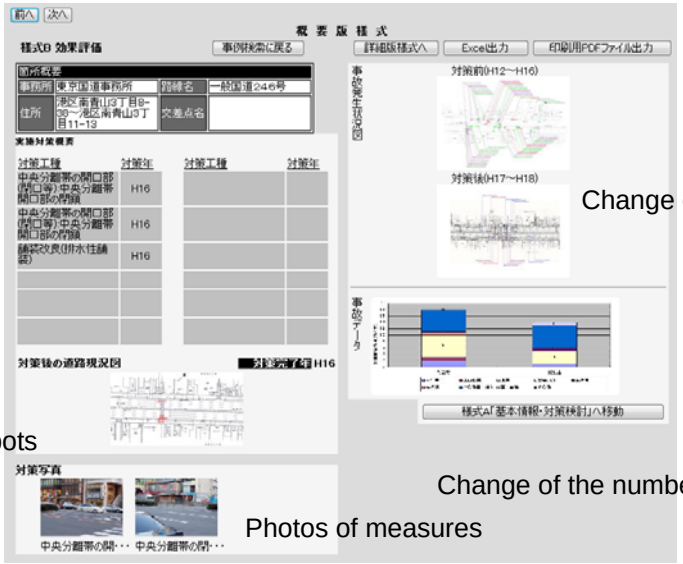
Input or revision of database is conducted collaborating with road administrator and police agency. These tusks filling forms or items in database are not always easy for road administrator. In 2009, the road safety database was reformed based on the needs and idea of road administrators. Figure-10 shows example of forms in revised database.

Table-2 Examples of items in database on road safety measures

Categories(Form No)		Examples of items
Before measures (Form 1)	Feature of spots (Form 1-1)	Road administrator, ID, address, name of spots, Shape, structure, Number of lane, ・・・・
	Traffic condition (Form 1-2)	Traffic volume, Degree of congestion, Phase of traffic signal, ・・・・
	Maps and photos (Form 1-3)	Maps, photos, ・・・・
	Accident situation (Form 1-4)	All of accident data, The number of traffic accident casualties (historical, accident pattern), ・・・・
Safety measures (Form 2)		Accident pattern, Accident occurrence mechanism, Road environment, Planning and Method of measures, ・・・・
After measures (Form 3)	Feature of spots (Form 3-1)	Road administrator, ID, address, name of spots, Shape, structure, Number of lane, ・・・・
	Traffic condition (Form 3-2)	Traffic volume, Degree of congestion, Phase of traffic signal, ・・・・
	Maps and photos (Form 3-3)	Maps, photos, ・・・・
	Accident situation (Form 3-4)	All of accident data, The number of traffic accident casualties (historical, accident pattern), ・・・・
Evaluation of measures (Form 4)		Change of the number of traffic accidents Change of traffic behavior Interview, ・・・・
Outline form A		See figure-10
Outline form B		See figure-10

(a) List of hazardous spots

(b) Outline form A (Before measures)



(c) Outline form B (After measures)

Figure-10 Example forms of database on road safety measures

6. Evaluation of safety measures

For road administrators, information on the effectiveness of major road safety measures is very important in the process of safety measure planning. NILIM is trying to propose unit coefficients of major safety measures based on the data in road safety database.

Table-3 shows the change of the number of accident before and after safety measures based on database on road safety measures. In the future, NILIM try to propose unit coefficients of road safety measures and reflect these outputs to the road safety manual. By using these unit coefficients we can conduct effective road safety management in view of micro and macro management.

Table-3 result of calculation unit coefficients

measure	The number of accident per year	
	Before measure	After measure
Traffic light	392	298
Road marking	709	568
Right turn lane	423	350
Color pavement	160	113

7. Conclusion

Japanese government is trying to decrease the number of traffic accident casualties to 2500 in 10 years. This is the half level of current number. In order to achieve this target, NILIM try to develop more effective road safety management system by introducing advanced technologies and effective use of past experience.

REFERENCES

[1] Institute for Traffic Accident Research and Data Analysis, The road safety manual, 5.2005

[2] National Institute for Land and Infrastructure Management, Research on creating safe roads and roadside environment in terms of Human-error control, PROJECT RESEARCH REPORT of NILIM No27, 2.2009